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A Literature Review of Advancing Early STEM Education in the GBA

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There are many previous studies indicating that STEM pedagogy has various positive functions for learners. However, the details of STEM education still need to be further studied to make it more widely available in early education. In this research, I will review the impact of STEM education on early childhood development through various literary theories. I hope to further conclude the influence of STEM education and its positive functions on children. It can provide information to pre-schools and early education centres to help more young children get early exposure to STEM education and develop their abilities in different aspects.

Keywords: ECE, Function, GBA, STEM Education

Introduction

The Guangdong-Hong Kong-Macao Greater Bay Area (GBA) is a bay area city group consisting of nine cities in the Pearl River Delta, Hong Kong and Macao, confirmed at the national level in China (Gu, et al., 2018). "International Science and Technology Innovation Center" has become the primary task and major strategy of the construction of the GBA (Lu, 2019), and universities, as the core force leading science and technology innovation, should assume important responsibilities in building the "International science and technology Innovation Center" of the GBA (Wang, 2019), to construct the integrated development mode dominated by the "university cluster-science innovation-industry" (Lu, 2019). In order to provide scientific research support for the upgrading of high-tech industries in the GBA, high-quality university resources in Hong Kong and Guangzhou should be fully utilized to promote knowledge innovation and technological research and development (Gu, et al., 2018).

STEM education can be a different perspective. For example, divided into broad and inclusive perspectives, including education in individual disciplines (science, technology, engineering, etc.), as well as interdisciplinary or interdisciplinary combinations (English, 2016; Honey et al, 2014; Kelley et al., 2016). STEM education focuses on the exploration of S (Science), T (Technology), E (Engineer) and M (Mathematics) (Barak et al., 2018), which integrates four disciplines into one organism (Chen, 2018). At the same time, this approach encourages children to explore the material world around them (Hua, 2020) and absorb knowledge in learning science, technology, engineering and mathematics (Kalogiannakis et al., 2018).

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The Concept of Early STEM Education

Educators from ECE regarded STEM education as an integral part of preschool (Tippett et al., 2017). NSTA (National Science Teachers Association, 2014) statement lays the foundation for a child's scientific learning process by focusing on the child's motivation which let them pay attention to the world surrounding them. In the meantime, make sure that various activities foster fun and curiosity. This means that children can increase their learning opportunities by observing, exploring and discovering the beauty around them. Campbell et al. (2018) believe that we can view preschool centres that provide diverse and abundant experiences for children to develop their understanding of STEM. From the national policy to the early education practice level, China has advocated and promoted STEM education. STEM education helps provide a foundation for important developmental education programs and instruction (Li et al., 2019). However, early childhood education (ECE) is excluded from this STEM learning process (Milford et al., 2015). Although high-quality ECE STEM experiences are likely to lead to academic success in future, educators still tend to focus on the k-12 STEM education instead of ECE (Human Learning Early Partnership, 2009). STEM in early childhood can make use of students' interests, experiences and prior knowledge to facilitate teachers to promote children's participation in activities better (NRC, 2011). STEM education provides outcomes in early childhood that improve children's school readiness and academic success (Brenneman et al., 2019), enabling children to think and be curious and interact with their lives (Simoncini et al., 2018; Tippet et al., 2017). Through robotics of STEM education, children can learn basic knowledge of programming skills and robotics (Sullivan et al., 2016).

Teachers play a vital role in stem education for preschool children through many studies. In recent years, Yang et al. (2021) regarded preparing early STEM education teachers as obviously becoming a key issue. According to the results of the survey from Zhang et, al., (2019), only 56% of the teachers have heard of preschool STEM education, and no more than 10% of teaching time from preschool to grade 2 was devoted to STEM content (Pantoya et al., 2015). These results may be due to a lack of early childhood teacher training and a lack of confidence among educators who allocate less time to STEM teaching (DeJarnette, 2018). Preschool teachers do not know much about how to carry out STEM education at the present stage (Zhang et al., 2019). There is no proper understanding of what STEM education is in fact (Hua, 2020), and we need to promote awareness of STEM education among teachers. STEM education in the GBA is booming, but it also faces some problems in STEM education in GBA, including an inadequate understanding of STEM and a lack of professionalism (Huang, et al., 2021).

GBA takes innovation and science and technology as the main axis and further pushes forward the corridor of science and technology innovation, which needs to be further strengthened (Gu, et al., 2018). Different scholars hold similar views on the significance of STEM education. But they elaborate from different angles, which further determines the complexity of STEM education in academic activities (Li et al., 2020). Therefore, in order to inform educators about the benefits of STEM and promote the application of STEM in teaching, this paper will look at the various functions of early STEM education.

The Function of The Early STEM Education

The Function I: Stimulate Learning Interest and Develop Learning Habits

STEM education is more interesting and conducive to strengthening children's learning initiatives (Qian, 2018). Early STEM education includes a group of problem-solving skills, thinking skills and a learning environment that involves scientific knowledge and processes to develop a child's curiosity about the world (Yelland et al., 2017). Children's curiosity and creativity make them have a natural tendency towards science (Dorado, 2020). In STEM education, children learn based on real-life and real problems. Therefore, children's learning goals can be connected with life experiences in a real living environment, and stimulate their internal interest in learning.

STEM corner environment aims to stimulate children's interest in active learning so that children can actively construct knowledge and experience in direct perception, practical operation and personal experience, and lead to actively explore (Ye, 2017), create a real living environment for children's active learning. Alade et al. (2016) emphasize that STEM can deliver science and math concepts to young children in different ways, such as robotics. Young children are interested in different aspects of programming and computational thinking but are not limited to robotics (Bers et al., 2014; Leonard et al., 2016). Because a child's learning is inspirational and holistic, STEM education can be combined in multiple ways to further stimulate a child's interest. In addition, the daily learning environment of STEM education is comfortable and attractive for children.

STEM courses are conducive to the cultivation of children's independent learning. Li (2020) regarded children can explore freely and independently according to their interests and hobbies. Meanwhile, they can also carry out independent extension and expansion of high-tech structural activities (Li, 2020). The potential of STEM is extraordinary, allowing students to learn more deeply and enjoy experimenting (Dorado, 2020). When children enjoy STEM classes, they can cultivate the habit of active learning.

The Function II: Cultivate Creative Thinking

STEM courses emphasize children's self-operation and exploration (Sun et al., 2019). Children are the main creators of their learning and positive meaning (Robbins, 2005). Most studies on early STEM education believe that engineering thinking is the soul of STEM learning, and scientific thinking is directional thinking, which helps to cultivate children's scientific spirit and innovative exploration thinking (Hua, 2021). Early childhood STEM education should give children a broad space for activities and thinking. In this way, children can be guided to think innovatively according to a theme, and finally reach the purpose of expanding and extending their innovative thinking.

Through STEM education, such as robotics and programming, children are opened to innovative thinking. At the same time, the application of appropriate interactive technology software provides significant benefits for preschool children's STEM learning, enabling them to think about how to deal with problems (Huber et al., 2016). Bybee (2013) also believes that STEM education cultivates students' ability to discover and solve problems. If children keep the pace up with STEM classes, their creative thinking will be gradually opened owing to each problem discovery and solution. Children's innovative thinking can be improved through various STEM activities, which is also an important function of STEM education.

The Function III: Develop Collaboration and Communication Skills

In STEM education activities, children need to cooperate to develop their ability to solve problems. Teachers should set up the environment in time to guide children to cooperate and communicate (Sun et al., 2019). STEM education allows children to learn actively through interactive group work (Çiftçi, 2020). In other words, children learn through social participation (Kampeza, 2020).

An important way to carry out STEM education in kindergartens is to advocate for children to actively discuss and explore together. One common STEM activity, for example, is making "bird feeders." In STEM education activities, teachers provide children with various equipment such as cardboard, foam, wood, pulley, etc., but after repeated operation and practice, children choose a pulley to feed the birds. A pulley is a technology used by children. During the whole process, in addition to the interest in learning, active learning and innovative thinking mentioned above, the children also learned how to communicate with their peers and completed many experiments together. In the early stage of education, STEM education emphasizes teamwork, encourages children to help each other to learn, and improves their teamwork and communication skills (Qian, 2018).

Within the educational framework of STEM, children can express their views through thought and conversation, communicate with each other, and feel encouraged to make decisions on issues (Kampeza, 2020). Finally, learning communities that can be formed in peer groups under the guidance of STEM provide positive psychological and behavioural guarantees for children's active learning (Du, 2017). Children can develop teamwork and communication skills under the guidance of STEM education.

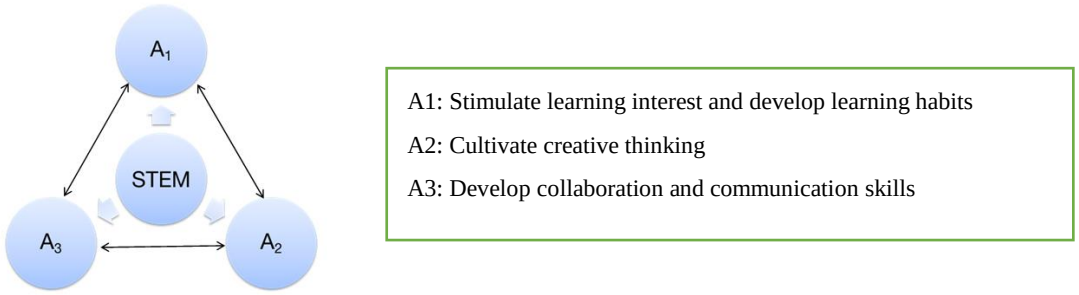

Figure 1. Relationship between influencing factors.

Conclusion

Early STEM education has become a focus of research and practice agendas because it can significantly predict a child's school readiness, academic achievement, problem-solving abilities, etc. (McClure et al., 2017). After the promulgation of a series of related policies, more and more kindergartens have become STEM education pilot schools in many areas such as Shanghai and Shenzhen—from the perspective of ECE practice (Hua, 2020). STEM education is not only an educational philosophy but also an educational model and learning method (Huang et al., 2014). Children's STEM tendencies are influenced by educators (Patrick et al., 2009). If we seek all students to succeed in different kinds of disciplines, then educators from various sectors (mainly teachers and researchers) should pay more attention to early STEM identity development. The key is to promote early childhood STEM education to play a greater role in early schools (Hachey, 2020).

McManis et al. (2012) put forward that STEM education technology can adapt to children's development if they are adapted to children's various factors, such as ages, cultural background, learning interests and learning needs, etc. At the same time, the interaction between children and their peers can stimulate their inspiration and help them develop their creative problem-solving skills (Chen, 2020). Teacher practice, curriculum and teaching choices have a significant impact on students' STEM orientation (McPhan et al., 2008). Therefore, after understanding the development trend of STEM education, we should realize the various functions that STEM education brings to children. Therefore, teachers' attention to STEM education needs to be further enhanced. When early STEM education is attached importance by teachers, teacher training in STEM education will develop rapidly. Ultimately, it is not only students who will benefit, but also educators.

Through many previous studies, we know that science, technology, engineering and mathematics can boost regional development in the era of the GBA's rapid development. Early STEM education may play an important role in the development of GBA. However, there are very few early STEM education studies in previous studies, and articles on the functions that STEM education brings to children are relatively scarce. The development of the GBA depends on technological innovation. STEM education can meet the needs of GBA development to some extent. Therefore, GBA should pay attention to early STEM education, and it is imperative to pay attention to training early STEM teachers.

Further data will be collected to make up for the data deficiencies of previous studies in the future. The next study is expected to confirm that STEM education can bring a variety of functions to GBA children, including improved interest in learning, innovative thinking and communication skills.

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